

Dermatological diagnosis by mobile application

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ABSTRACT

Health care mobile application delivers the right information at the right time and place to benefit patient's clinicians and managers to make correct and accurate decisions in health care fields, safer care and less waste, errors, delays and duplicated errors. Lots of people have knowledge a skin illness at some point of their life, For the reason that skin is the body's major organ and it is quite exposed, significantly increasing its hazard of starting to be diseased or ruined. This paper aims to detect skin disease by mobile app using android platform providing valid trustworthy and useful dermatological information on over 4 skin diseases such as acne, psoriasis content for each skin condition, skin rash and Melanoma. It will include name, image, description, symptoms, treatment and prevention with support multi languages English and Bahasa and Mandarin. the application has the ability to take and send video as well as normal and magnified photos to your dermatologist as an email attachment with comments on safe secure network, this app also has a built in protected privacy features to access to your photo and video dermatologists. The mobile application help in diagnose and treat their patients without an office visit tele dermatology is recognized by all major insurance companies doctor.

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1. INTRODUCTION

Skin disease is the most common disease form in the world. The diagnosis of the skin diseases requires a high level of expertise and they are subjective to the dermatologist, so computer aided skin diseases diagnosis system is proposed to provide more objective and reliable solution to this problem [1]. Skin is the largest organ in human body, which is important to cover human bone, and to protect human from any harm, fight the bacteria and other kind of diseases [2], and may have numerous potential abnormalities. Several factors may affect the skin directly or indirectly and cause diseases which can be treated with specific medicine and others require doctor's consultation. This paper will help people to know what are the required procedures for treatment of skin disease [3] by analyzing the image and extract useful information that help to show the infected skin area and classification of image based on the kind of skin disease, and show emergency medical services if it is possible and normal to reassure people.

There are many skin diseases including skin cancer, eczema, allergies. The focus of this paper will be of four types of most common dermatological, where the image will be taken either directly from the mobile camera or choose it from database and then analyzes the image and isolate the skin area and extract the affected area. The most common skin diseases discussed in this paper are: Acne, Psoriasis, Melanoma, Heat Rash. In acne [4] condition it includes whiteheads, blackheads, red and inflamed patches and it occurs mainly on face and shoulders. Psoriasis is a harmful and hazardous form of skin disease, with increasing rates and subjectivity in a different type of current clinical skin detection global methods, there is a need for skin

disease detection decision support system in which feature extraction is a sharp critical and valuable step in skin disease decision support system. In this paper the percentage of validation and accuracy was 90.09% and it's achieved by using KNN (Neural Network) algorithm. Melanoma is the most dangerous form of skin cancer [4] if left untreated. the rates of melanoma have been increasing, especially among young adults, but survival rates are high if detected it early. Unfortunately, the time and costs required by dermatologists to check all patients for melanoma are very expensive. There is a need for an automated system to assess a patient's risk of melanoma using images of their skin diseases. The percentage of validation and accuracy in this paper was 82.5% by using MSIM algorithm to achieve better result. Dermatologists could use the system to help to diagnose without the need for special or expensive equipment. The last one is Heat Rash or Prickly Heat, caused by excess sweating and inadequate evaporation of the sweat. If this occurs at the surface of the skin, small vesicles (blister-like sacs containing fluid) which are not inflamed, occur on the skin surface (miliaria crystallina). These blisters last only a few hours and burst spontaneously.

While several research papers analyze only one disease like Melanoma cancer scope. Depend on digital images to detect apart of lesion area easily and propose skin lesion segmentation algorithm to segment lesion area and extract features and classify the region if it is normal or lesion in terms of the risk of melanoma. Also analyze the skin disease using texture analysis of skin image [5] and by comparing the test image to a defined images or reference images. The matching of test and reference images compared that yields the percentage of skin diseases in the captured skin texture image. The analysis result of this research paper is not accurate and unreliable. So that is achieving the percentage of validation and accuracy about 78%. The research of automatic detection of eczema using image processing, detects eczema regions and classify the identified region as mild or severe based on image color feature and texture feature. It is achieve good result of validation and accuracy about 92%.

In Figure 1, shows the most common skin diseases will discussed and processed in this paper. It is expected that our proposed system gives better results than the previous research mentioned because it uses two powerful algorithms K-means and Fuzzy C-means, which give better and accurate results than from others.



Figure 1. The skin diseases, (a) Acne diseases, (b) Psoriasis, (c) Melanoma, (d) Heat rash

2. RESEARCH METHOD

In this section, the methodology of the proposed image analysis model for skin diseases detection are discussed. the system architecture can be divided into several important steps which include: apply enhancement on the captured image, segmentation the image, feature extraction, classification, and the expected severity [6].

After that, need for two segmentation algorithm to be used in this model, firstly: apply the segmentation algorithm for skin detects to produce a mask for separate skin area in the picture. When the skin area is separated, then used the second segmentation algorithm to get the disease area in the skin area. The result of this research paper proposed shown in Figure 2, we will notice these steps a,b,c below:

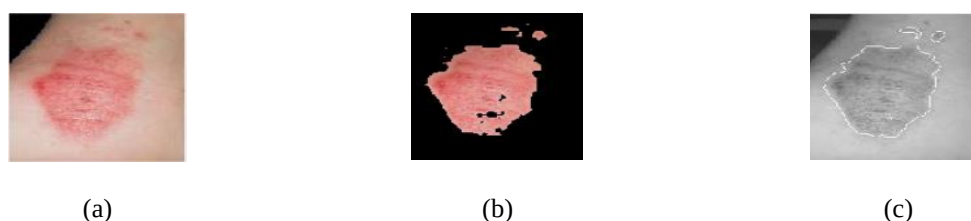


Figure 2. Diseases segmentation

The model architecture can assume in several steps shown in Figure 3 that is flowchart show how analysis image and skin diseases detection.

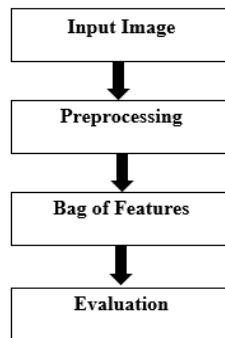


Figure 3. Image analysis model for skin disease detection

2.1. Input image

Input image is the first step in work-flow to begin the model, so it's go through the process involves either to capture the image of the skin disease area from camera mobile or can choose image from database. This is first and important step, because without the image, no further process is possible.

2.2. Enhancement process (pre-processing)

The enhancement process is to apply modification filter called Gaussian filter to smoothen the image either that is captured now or from database, to destroy from unwanted element in the image like noise by applying median filter. Firstly the input image that choosing an image resizes the image to uniform scale 360x360 [7]. The image is then converted from RGB (Red Green Blue) to gray scale, then apply contrast enhancement to improve the image quality for better performance. Sometimes need to remove hair from the skin image, to analyze the image better for accurate result [8]. In Figure 4, explain the description enhancement process chart, which makes the image ready for the next processing step.

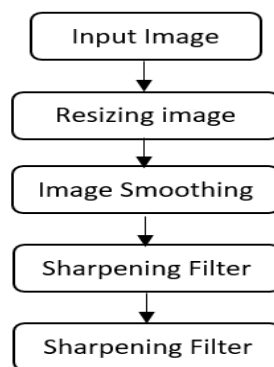


Figure 4. Enhancement process

2.2.1. Re-sizing image

Re-sizing image is important step to have uniform size for all images, and therefore the downsize an image or enlarge an image it's very easy, but remember its resize an image can make its pixel information is changed [9]. And in our proposed model skin diseases detection the most important thing, the images should be very clear with high resolution and quality for extract features that help in diagnose which type of skin diseases.

2.2.2. Image smoothing

Skin diseases images obtained generally include noise and hair, air bubbles and background noise, thus noise reduction technology is used in this model that the segmentation results will be good. The Smoothing filter used in frequency domain is Gaussian Filter, it is the most commonly used in medical field. The Gaussian filter can be derived as:

$$I(X) = \frac{1}{2\pi\sigma^2} \cdot e^{-\frac{x^2+y^2}{2\sigma^2}} \cdot I(Y)$$

2.2.3. Sharpening filter

In medical field per skin diseases detection is highly sensitive to edge and fine details of an image, the visual quality of image can be enormously degraded if it has high frequencies are reduced or completely removed. In contrast, enhancing the frequency component of the image to enhancement in the visual quality [10]. Image sharpening refers to any enhancement technique that highlights edges and fine details in an image. In the next Figure 5, illustrates the result of applying sharpening filter on the image.



Original image

Sharpened image

Figure 5. Sharpened filter on the image

2.3 Bag of features

The aim of these steps is to extract meaningful features of the image diseases area that can help in identification and evaluation of diseases state.

- a. Color Features: it is the most common color features, which is the average value for color in several color channels. Color channels that are used to capture color differences are gray, Red, Green, Blue (RGB), Hue and Value (from HSV color-space), Luminance and Chrominance (from YCbCr color space). In this paper, ten features are extracted for color features description for the diseases area [11].
- b. Texture Features: it is a matrix called GLCM (Gray Level Co-occurrence Matrix) of a gray scale image. It is depended texture analysis in one or more the most common method for selecting texture features. The texture features of an image are described by tabulating how often a combination of pixel with specific brightness level of a skin image in a specific spatial direction [12]. The extracted features from the (GLCM) matrix are used to describe the area from contrast, energy, correlation, and homogeneity.

2.3.1. Segmentation

The aim of this process is to distinguish between the diseases area and skin area. To detect the diseases area correctly, should apply a segmentation method with high accuracy. The best methods that give good results, the color-based segmentation method based on K-means clustering method. Clustering is a technique to divide the image into K groups of clusters based on the Euclidean distance of an image pixel from a selected cluster centroid. The algorithm firstly initializes K for the centroid for each of K numbers of clusters by computing a histogram of the image. Then add each pixel in the image to this group, if the difference between pixel value and centroid value is minimum, then the clustering can be applied spatially or in color space [13].

As the K-means algorithm, the desired number of clusters C has to be pre-defined and C initial seeds of clustering are required performing the Fuzzy C-means algorithm. Contrary to the K-means method, the Fuzzy C-means is more flexible because it shows those objects that have some interface with more than one cluster in the partition. May be when apply two algorithms K-means clustering and fuzzy C-means and show the two of results and compare between them. That leads to a good accurate result with little chance of error.

The clustering algorithm is very sensitive for objects in the image, because the objects tend to have similar properties. So, converted the RGB image into L*a*b color to describe more precisely and intensity for the color. Then segment the diseases area by using clustering algorithm. And repeat the clustering method may be three times, it's enough to reduce the local minima. After that, will apply several image processing techniques, like erosion and dilation, were applied in the segmented eczema cluster. All the tiny holes were removed, and a continuous region of the affected area was separated. Figure 2 shown the process of filtering the skin detect area then could process to next step.

2.3.2. Classification

Total images in database included around 100 images of healthy skin, and skin with mild diseases and with severe diseases. And the images are classified as healthy skin or mild diseases, or severe diseases images. When different visual vocabularies are obtained then each image is described using these vocabularies, the histogram of each visual vocabulary is determined and stored in what is called feature vector [14], all vectors of all images represent the input to the classifier. In this paper, classification Support Vector Machine (SVM) classifier is used; since the input data is complicated and nonlinearly then SVM with Radial Basis Function kernel is used. There are many types of radial basis functions such as Gaussian radial basis function, Multi-Quadric Functions and Thin Plate Spline Function.

2.4. Evaluation

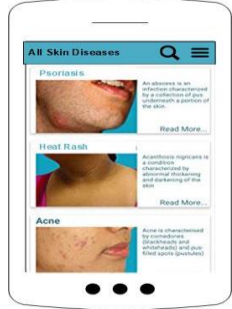
In the training model, we use 100 image of each class, 50 of them were colored images, and another 50 were gray images. The dataset was segmented to 60 percent of images used for training our model and 40 percent used for evaluation [15]. In our training model we use Bag-of-Features and implemented in Android studio platform by Java language for generate mobile application.

3. RESULTS AND ANALYSIS

When user installs the application in his phone, can easily use it when choose the photo and begin processing for 10- 20 seconds and show the result immediate. So the connect between application and database it is easy once the image is taken, connecting to the database is created then give what is the desired.

Mainly there are several interfaces for use the application and it is supposed to be implemented in the application will show in Table 1, provides a simplified explanation of what the application has done to detect skin diseases.

Table 1. Application interfaces

Interfaces	Description
	When the user open the skin care application from the list of phone application. Main interface showed contains application logo with 3 buttons and burger menu.
	When the user choose "All Skin Diseases" button, will show another interface illustrate the types of skin diseases that diagnosed by this application: Acne, Psoriasis, Melanoma, Heat Rash, with possibility read each skin what is causes, sign and symptoms, Risk factors, when to see doctor, diagnosis, treatments, prevention, and all possible complications. This app high quality images for the most common diseases and conditions. It has a search bar to enable easy search for a skin disease.

Interfaces	Description
	If the user choose “Skin Care” button from main interface will be show skin care tips for common skin problems.
	In the main interface when choose burger menu, it will open with many options like: Home for go back to the Main interface, Uploaded Image for doing checkup for skin image and show the result. This app support multi-language for English, Malaysian and Chinese people. Can choose the compatible language for the user from burger menu.
	When choose uploaded image from burger menu, this is the first step for doing checkup and processing on the uploaded image either captured live image directly or choose it from database.
	The image uploaded successfully by choose it from camera or existing image in database, will show tips “uploaded image is done” with two options: 1- Doing checkup for this image and detect the skin diseases by analysis the image with suitable algorithm and analysis technique. 2- Cancel this step, and go back to main menu.
	When doing checkup on the skin image. The analysis technique and checkup process will take 1- 2 minutes and show the checking up result with possibility to read some information about the skin diseases detected. After that, the user can share the result on Social Media like Facebook, Twitter, even can send the result as attachment to doctor by Email.
	Read the information about the skin diseases detected it is important for user to create the knowledge about the skin disease like, what is causes, sign and symptoms, Risk factors, when to see doctor, diagnosis, treatments, prevention, and all possible complications.

4. CONCLUSIONS

In this research paper can used as an effective, low cost solution for skin diseases detection by a computer aided system is proposed to resolve difficulties that's created from challenges faced from the dermatologist to recognize the different skin diseases easily. Firstly applied enhancements to remove the noise, two noise reduction technologies were investigated. Gaussian filter and median filter were compared in the noise reduction and compared four color spaces (RGB, YUV, HSV and YCbCr) for skin lesion extraction and feature extraction and to improve computation efficiency. This model is built in mobile application with user friendly interfaces and clearly steps.

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REFERENCES

- [1] A. Haddad and S. A. Hameed, "Image Analysis Model For Skin Disease Detection: Framework," *2018 7th International Conference on Computer and Communication Engineering (ICCCE)*, Kuala Lumpur, 2018, pp. 1-4.
- [2] Sumithra Ra, Mahamad Suhilb, D.S.Guruc, "Segmentation and Classification of Skin Lesions for Disease Diagnosis", *Elsevier Procedia Computer Science, International Conference on Advanced Computing Technologies and Applications (ICACTA-2015)*, 2015.
- [3] Mohammad H. Jafari, Ebrahim Nasr-Esfahani, Nader Karimi, S.M. Reza Soroushmehr, Shadrokh Samavi, Kayvan Najarian, "Extraction of Skin Lesions from Non-Dermoscopic Images Using Deep Learning", *Springer Int J Comput Assist Radiol Surg*. Jun;12(6):1021-1030. 2017.
- [4] Manish Kumar and Rajiv Kumar, "An Intelligent System To Diagnosis The Skin Disease", *ARNP JEAS*, Vol. 11, No. 19, pp.: 11368-11373, October 2016.
- [5] Jerrey Glaister, "Automatic segmentation of skin lesions from dermatological photograph", Waterloo, Ontario, Canada, 2013.
- [6] K.Indupriya, Dr. G. P. Ramesh Kumar, "A Survey On Skin Texture Analysis For Medical Diagnosis Using Image Processing Techniques", *Intern. Journal of Science, Engin., Technol. (IJSET)*, Vol. 3 Issue No. 5, pp.: 1161-1163, 2015.
- [7] M. N. Alam, T. T. K. Munia, K. Tavakolian, F. Vasefi, N. MacKinnon and R. Fazel-Rezai, "Automatic detection and severity measurement of eczema using image processing," *2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, Orlando, FL, 2016, pp. 1365-1368.
- [8] T.S Gunawan, A. Mutholib, M. Kartiwi, "Design of Automatic Number Plate Recognition on Android Smartphone Platform," *Indonesian Journal of Electrical Engineering and Computer Science*, 5(1), pp. 99-108, 2017.
- [9] Er.Shrinidhi Gindhi, Ansari Nausheen, Ansari Zoya, Shaikh Ruhin (2017), "An Innovative Approach for Skin Disease Detection Using Image Processing and Data Mining", *International Journal of Innovative Research in Computer and Communication Engineering* .Vol. 5, Issue 4, April 2017.
- [10] Abhijith L Kotian, Deepa K (2017), "Detection and Classification of Skin Diseases by Image Analysis Using MATLAB", *International Journal of Emerging Research in Management & Technology* ISSN: 2278-9359 (Volume-6, Issue-5) 2017.
- [11] Lakshay Bajaj, Himanshu kumar, Yasha Hasija (2018), "Automated System for Prediction of Skin Disease using Image Processing and Machine Learning", *International Journal of Computer Applications (0975 – 8887)* Volume 180 – No.19, February 2018.
- [12] Pravin S. Ambad, A. S. Shirsat (2016), "A Image analysis System to Detect Skin Diseases", *IOSR Journal of VLSI and Signal Processing (IOSR-JVSP)*. Volume 6, Issue 5, Ver. I (Sep. - Oct. 2016).
- [13] Nisha Yadav, Virender Kumar Narang, Utpal shrivastava (2016), "Skin Diseases Detection Models using Image Processing: A Survey", *International Journal of Computer Applications (0975 – 8887)*. Volume 137 – No.12, March 2016.
- [14] R. S. Gound ,Priyanka S. Gadre, Jyoti B. Gaikwad, Priyanka K. Wagh (2018), "Skin Disease Diagnosis System using Image Processing and Data Mining", *International Journal of Computer Applications (0975 – 8887)*. Volume 179–No.16, January 2018.
- [15] Mariam Ahmed Sheha, Amr Sharwy , Mai S. Mabrouk (2016), "Automated Imaging System for Pigmented Skin Lesion Diagnosis", *International Journal of Advanced Computer Science and Applications*, Vol. 7, No. 10, 2016.

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